REMARKS/ARGUMENTS

In the Office Action, the Examiner noted that claims 1-45 are pending in the application. The Examiner additionally stated that claims 1-45 are rejected. By this amendment, claims 1, 5, 9, 16, 23-24, 27, 30, and 40 have been amended. Hence, claims 1-45 are pending in the application.

Applicant hereby requests further examination and reconsideration of the application, in view of the foregoing amendments.

In the Specification

Applicant has amended the specification to secure a substantial correspondence between the claims amended herein and the remainder of the specification. No new matter is presented.

In the Claims

Rejections Under 35 U.S.C. §103(a)

The Examiner rejected claims 1-22 and 27-39 under 35 U.S.C. 102(e) as being anticipated by Susnow et al., US 6,751,235 (hereinafter, Susnow) in view of Cheriton et al., US 6,675,200 (hereinafter Cheriton). Applicant respectfully traverses the Examiner's rejections.

Prior to providing a claim-by-claim analysis, an overview of the teachings of Susnow and Cheriton are is now provided to aid the Examiner in his reconsideration of the rejections.

Susnow teaches a technique for synchronizing a communication link by a network interface having a transmitter in a core clock domain that is different from the link clock domain of the communication link (Abstract). With regard to application of his invention, Susnow states that it is applicable for use with all types of computer networks including designs which link together disparate processing systems. Of the examples of such networks, Susnow includes NGIO and Infiniband (col. 2, lines 40-52). With particular reference to configuration of a host processing system 330 according to his invention, Susnow introduces a fabric channel adapter 339 that is connected between the I/O and memory controller 333 and the network switching fabric 100. Susnow states that

the channel adapter 339 (339' if it is connected to a PCI bus) may have therein a software stack to access the network fabric 100 and information about fabric configuration, fabric topology, and connection information. Although not shown, Susnow notes that an operating system within the host 330 performs common functions such as sending and receiving I/O transaction messages and remote direct memory access operations (col. 3, line 67- col. 4, line 42). Although Susnow teaches the architecture of a typical present day computer network in the noted paragraphs, the problem that he notes and which he addresses is synchronization of physical layer communication links between a core clock domain and a link clock domain, as discussed with reference to figures 7-9. Susnow does not address TCP/IP offload of a server. In fact, one skilled in the art can infer from the teachings of Susnow that he is addressing a problem inherent in a communication system that employs VI as an upper layer protocol. Several problems exist because VI does not specify an underlying transport mechanism. Susnow lists these limitations stating that "there are no provisions for flow control, buffer management, segmentation and reassembly, and link synchronization." (col. 6, lines 49-52) The remainder of his patent focuses on how to address the link synchronization limitation. He alludes to rdma functions in passing as functions common to host adapter drivers and also refers to Infiniband and NGIO as other architectures to which his link synchronization solution applies, and such may be true, but his characterization of these functions and architectures is restricted to dealing with link synchronization issues.

Cheriton teaches modifying a standard TCP header (see Fig. 1) to provide for an RDMA option, where a sender *must place option bytes in the header of each TCP segment containing RDMA data.* The RDMA option bytes describe the location of the RDMA data in the TCP payload to the receiver, which allows the receiving system to load the RDMA data directly to an application memory without making intermediate copies. Thus, Cheriton teaches a protocol that is embedded within a TCP segment that directs a receiver to execute an RDMA operation that is associated with payload data within that TCP segment. Cheriton's goal is to reduce the amount of data copying needed to transfer large blocks of data over a network and his particular application is to moving data over a storage area network. By laying a shim protocol on top of TCP, but logically underneath

higher level disk and file access protocols (e.g., SCSI), the location of RDMA data within a TCP payload is identified and can be appropriately moved to memory. (col. 1, line 37 through col. 2, line 20) Cheriton's invention does reduce the number of intermediate buffer copies required over a TCP/IP network, but he does not bypass TCP/IP processing on a server's TCP/IP stack.

In contrast, Applicant's invention is directed toward techniques that allow servers to offload TCP/IP-related processing, where the server is connected to plurality of clients, and the plurality of clients are accessed via a TCP/IP network . TCP/IP connections between the plurality of clients and the server are accelerated. The apparatus includes an accelerated connection processor and a target channel adapter. The accelerated connection processor bridges TCP/IP transactions between the plurality of clients and the server, where the accelerated connection processor accelerates the TCP/IP connections by intercepting send/receive commands provided to the server's TCP/IP stack and prescribing Infiniband remote direct memory access operations to retrieve/provide transaction data from/to the server. The target channel adapter is coupled to the accelerated connection processor. The target channel adapter executes the remote direct memory access operations to retrieve/provide the transaction data. The TCP/IP transactions are accelerated by offloading TCP/IP processing otherwise performed by the servers to retrieve/provide transaction data.

Although Susnow's host system is capable of performing remote direct memory access operations (as would any Infiniband-based host adapter), nowhere within the specified reference does he suggest acceleration of a TCP/IP connection by intercepting commands provided to a server's TCP/IP stack and prescribing remote direct memory access operations, where TCP/IP transactions are accelerated by offloading TCP/IP processing otherwise performed by servers to retrieve/provide transaction data. Susnow does not even identify TCP/IP processing in a server as a problem to be solved. This is because Susnow is concerned with synchronizing physical layer communications over a disparate computer network—exclusively. Susnow does not address acceleration of a TCP/IP connection. And Cheriton does not address use of Infiniband, or any other rdma-capable network, to accelerate TCP/IP connections. Furthermore, neither of the two references

suggest that TCP/IP connections can be accelerated by intercepting commands provided to a server's TCP/IP stack, and transferring the data via Infiniband remote direct memory access operations.

Claim 1, as amended, is provided below for ease of reference.

1. A TCP-aware target adapter, for accelerating TCP/IP connections between a plurality of clients and a plurality of servers, the plurality of servers being accessed via an Infiniband fabric, the plurality of clients being accessed via a TCP/IP network, the TCP-aware target adapter comprising:

   an accelerated connection processor, configured to bridge TCP/IP transactions between the plurality of clients and the plurality of servers, wherein said accelerated connection processor accelerates the TCP/IP connections by intercepting commands provided to the servers' TCP/IP stacks and prescribing Infiniband remote direct memory access operations to retrieve/provide transaction data from/to the plurality of servers; and

   a target channel adapter, coupled to said accelerated connection processor, configured to support Infiniband operations with the plurality of servers, and configured to execute said remote direct memory access operations to retrieve/provide said transaction data;

   whereby the TCP/IP connections are accelerated by offloading TCP/IP processing otherwise performed by the plurality of servers to retrieve/provide said transaction data.

In rejection of claim 1, the Examiner states that Susnow teaches a TCP-aware target adapter (Fig 3, item 360), for accelerating TCP/IP connections between a plurality of clients and a plurality of servers (Col. 3, lines 47-53), the plurality of servers being accessed via an Infiniband fabric (Col. 2, lines 55-60), the plurality of clients being accessed via a TCP/IP network (Col. 6, lines 28-45, wherein the VI is an improvement of TCP/IP, V1 contains transport level reliability functions, and is able to allow faster I/O communication between network devices, in other words, VI interface is a scaled down

version of TCP/IP protocol for improvement in speed and reduction of software overhead), the TCP-aware target adapter comprising:

an accelerated connection processor, configured to bridge TCP/IP transactions between the plurality of clients and the plurality of servers (Fig 3, item 330), wherein said accelerated connection processor accelerates the TCP/IP connections by prescribing remote direct memory access operations to retrieve/provide transaction data from/to the plurality of servers (Col. 4, lines 40-41); and

a target channel adapter (Fig 4, item 339, it should be noted that Host and Target channel adapter's naming convention is direction specific, host transmits data to the receiver, host channel adapter have similar purpose as target channel adapter, they both interface the host to the Infiniband network, this can be supported in Col. 3, lines 42-60), coupled to said accelerated connection processor, configured to support Infiniband operations with the plurality of servers, and configured to execute said remote direct memory access operations to retrieve/provide said transaction data (Col. 4, lines 30-41; Col. 3, lines 47-55).

In addition, the Examiner notes that Susnow does not explicitly teach:

Whereby the TCPIIP connections are accelerated by offloading TCP/IP processing otherwise performed by the plurality of servers to retrieve/provide said transaction data, but that, in a similar system, Cheriton teaches using RDMA in a TCP/IP framework (Col. 3, lines 39-57). Specifically, that Cheriton discloses of the overhead caused by traditional memory copy operations (Col. 3, lines 27-31), and a method to overcome such deficiencies by using RDMA in order to improve performance. The Examiner stated that the offloading is equivalent to RDMA process wherein a remote device performs functionalities on server's behalf so server's resources are freed up. The Examiner concluded that it would have been obvious to the person ordinary skilled in the art at the time of the invention to combine teachings of Susnow and Cheriton and to have used RDMA to accelerate TCP/IP communications in Susnow's system for the performance gain achieved by using RDMA (Col. 3, lines 39-47).

Applicant respectfully disagrees with the Examiner's characterization of the teachings of Susnow for the following reasons. First, Susnow does not teach, or even suggest, that TCP/IP connections between a plurality of clients and a server can be accelerated by prescribing remote direct memory access operations. Although he does discuss using VI, circuitry of which is provided within a virtual expansion bridge 670 in his invention, it is taught that the function of the bridge 670 is to transition data from an NGIO or Infiniband host channel adapter therein to the memory controller hub 620 (col. 6, lines 18-20). Susnow teaches that the VI architecture, while providing high reliability, does not specify the implementation of certain transport level functions to include flow control, buffer management, segmentation and reassembly, *and link synchronization*, the problem noted and addressed by the noted reference. Thus, it follows that Susnow teaches utilizing an NGIO or Infiniband fabric to execute VI transactions between his host system 330 and other devices as noted in Figure 3. In fact, it is the particular employment of VI that creates the very link synchronization problem which is pointed out by Susnow.

Furthermore, Applicant respectfully disagrees with both the Examiner's and Susnow's characterization of the VI architecture as being a modified version of TCP/IP. More specifically, the VI Architecture Specification cited by Susnow (col. 6, lines 42-48) does not specify a particular implementation of transport, network, or link layers. A VI configuration can be implemented without employing TCP/IP. In another reference, for example, that was provided by the Examiner in the instant office action ("Virtual Interface (VI) Architecture Overview"), Pathikonda et al. teach that VI needs to be fully defined to allow implementation (p. 25) and that the VI specification is OS, processor, and interconnect independent (p. 9), and that VI architecture is interconnect neutral (p. 32). Applicant would like to specifically and respectfully point out that Susnow does not teach that VI is a modified or improved version of TCP/IP, as the Examiner has inferred. Rather, Susnow states, but provides no specific support for, that VI is "an improvement over TCP/IP communication protocols in certain network environments." (col. 6, lines 29-30). One is left to infer the reasoning for Susnow's statement about VI from the context of his patent. Certainly VI specifies reliable connections. *But VI does not specify underlying transport and network mechanisms.* And since VI does not specify the

underlying transport and network mechanisms, then it cannot be inferred that VI is either a modified or an improved version of TCP/IP. Rather, all that can be inferred is that VI is an upper layer protocol that provides for RDMA, and that no underlying transport mechanisms are specified. And even to add an RDMA protocol on top of TCP/IP does not suggest or provide any motivation to accelerate a TCP/IP connection, as Applicant has noted in the instant application. Thus, it is an improper to infer that Susnow teaches acceleration of TCP/IP connections. In fact, Susnow goes on to set up his link synchronization problem by listing transport level functions that TCP/IP provides (e.g. flow control, segmentation and reassembly, and link synchronization), but which VI does not perform. (col. 6, lines 49-52) In essence, Susnow is dealing with a problem created by having a VI-based system that is trying to communicate in the absence of features provided by TCP/IP. His link synchronization inventions is actually attempting to add a feature of TCP/IP to address a limitation of VI.

Thus, one skilled in the art will conclude that Susnow does not teach VI as an improved version of TCP/IP—he does not state this at all—but rather that VI is an improvement over TCP/IP protocols in certain environments in the sense that VI specifies a reliable connection. That is the extent of Susnow's teaching regarding TCP/IP. The Examiner has stated that the VI architecture is disclosed numerously in the forgoing office action and with the IDS, and thus there is no need to further elaborate. Applicant respectfully disagrees and notes that VI does not specify an underlying transport mechanism. One skilled in the art will concur that the goal of the those developing the VI architecture was to specify RDMA capabilities without specifying underlying transport. Infiniband, in contrast, improved upon the RDMA capabilities of VI and furthermore specifies an underlying transport and physical layer. Thus, Applicant wishes to address acceleration of TCP/IP connections by taking advantage of the RDMA capabilities of Infiniband within a server network, by intercepting commands provided to a server's TCP/IP stack and prescribing Infiniband RDMA operations to accomplish the data transfer. VI is definitely not an alternate version of TCP/IP, nor is it a modified version of TCP/IP, for VI does not specify an underlying transport. VI can indeed by employed over the top of TCP/IP, but Susnow does not teach this. Rather, Susnow shows VI over the top of

Infiniband or NGIO (see Fig. 6, element 371). But both VI and Infiniband specify reliable connections and RDMA, so one skilled in the art would conclude from the discussion with reference to figure 6 that Susnow wishes to employ NGIO or Infiniband underlying transport mechanisms in a VI-based system.

And Susnow certainly does not teach that a TCP/IP connection can be accelerated by intercepting commands provided to a server's TCP/IP stack and through the employment of Infiniband remote direct memory access operations, whereby the TCP/IP connections are accelerated by offloading TCP/IP processing otherwise performed by the plurality of servers to retrieve/provide said transaction data. Applicant has studied the teachings of Susnow and finds that he utterly fails to teach, suggest, allude to, or even hint that one skilled in the art would be motivated to accelerate a TCP/IP connection by intercepting commands provides to a TCP/IP stack and by prescribing remote direct memory access operations to send/receive transaction data.

In addition, Cheriton refers to RDMA in the sense that an option field must be provided in a TCP header to identify data within the TCP payload that can be placed in memory directly rather than undergoing the buffer copies required by a TCP/IP stack. But intermediate buffer copies only reduces the overhead of TCP/IP. Cheriton does not mention reducing other overhead-related functions such as context switches, etc. Thus, Cheriton does not teach offloading in the sense that Applicant teaches in the instant application. Rather, Applicant teaches offloading by intercepting commands provided to a server's TCP/IP stack and prescribing Infiniband RDMA operations to retrieve/provide said transaction data. And the only context that Cheriton mentions Infiniband within is to identify Infiniband as a new protocol that responds to the problem of unacceptable overhead requirements in network remote DMA. (col. 1, lines 55-61)

For these reasons, it is respectfully requested that the rejection of claim 1 be withdrawn.

With respect to claims 2-8, these claims depend from claim 1 and add further limitations that are neither anticipated nor made obvious by Susnow, Cheriton, or Susnow and Cheriton in combination. Accordingly, Applicant respectfully requests that the Examiner withdraw his rejections to claims 2-8 as well.

Independent claims 9, 16, 27, and 30 recite substantially similar limitations as claim 1, in particular:

- Intercepting send/receive commands provided to a TCP/IP stack; and
- Prescribing RDMA transactions over an Infiniband fabric to accelerate transfer of data corresponding to the TCP/IP connections, thereby bypassing the TCP/IP stack.

And, as argued above in traversal of the rejection of claim 1, neither Cheriton nor Susnow teach or suggest the above-noted limitations. Rather, Susnow addresses a problem inherent in a VI-based system and attempts to provide attributes of TCP (i.e., link synchronization) and Cheriton proposes a shim protocol on top of TCP to allow for data placement in memory. Consequently, Applicant respectfully requests withdrawal of the rejections of claims 9, 16, 27, and 30.

With respect to claims 10-15, these claims depend from claim 9 and add further limitations that are neither anticipated nor made obvious by Susnow, Cheriton, or Susnow and Cheriton in combination. Accordingly, Applicant respectfully requests that the Examiner withdraw his rejections to claims 10-15 as well.

With respect to claims 17-22, these claims depend from claim 16 and add further limitations that are neither anticipated nor made obvious by Susnow, Cheriton, or Susnow and Cheriton in combination. Accordingly, Applicant respectfully requests that the Examiner withdraw his rejections to claims 17-22.

With respect to claims 28-29, these claims depend from claim 27 and add further limitations that are neither anticipated nor made obvious by Susnow, Cheriton, or Susnow and Cheriton in combination. Accordingly, Applicant respectfully requests that the Examiner withdraw his rejections to claims 28-29.

With respect to claims 31-39, these claims depend from claim 30 and add further limitations that are neither anticipated nor made obvious by Susnow, Cheriton, or Susnow and Cheriton in combination. Accordingly, Applicant respectfully requests that the Examiner withdraw his rejections to claims 31-39.

The Examiner rejected claims 40-45 under 35 U.S.C. 103(a) as being unpatentable over Susnow, in view of Johnson U.S. Patent No. 6,591,310. Applicant respectfully traverses.

Claim 40 is repeated below for ease of reference.

40. An Infiniband-to-native protocol translation apparatus, for routing TCP/IP transactions between a plurality of clients and a plurality of Infiniband devices, the plurality of Infiniband devices being accessed via an Infiniband fabric, the plurality of clients being accessed via a TCP/IP network, the Infiniband-to-native protocol translation apparatus comprising:

an unaccelerated connection processor, configured to bridge the TCP/IP transactions between the plurality of clients and the plurality of Infiniband devices by intercepting commands provided to corresponding TCP/IP stacks within the plurality of Infiniband devices, and encapsulating/stripping the TCP transactions within/from Infiniband raw packets, said unaccelerated connection processor comprising:

an unaccelerated connection correlator, for mapping native addresses to/from Infiniband local indentifiers and work queue numbers; and

a target channel adapter, coupled to said unaccelerated connection processor, configured to receive/transmit said Infiniband raw packets from/to the plurality of Infiniband devices.

In his rejection, the Examiner noted that Susnow teaches an Infiniband-to-native protocol translation apparatus, for routing TCP/IP transactions between a plurality of clients and a plurality of Infiniband devices, the plurality of Infiniband devices being accessed via an Infiniband fabric, the plurality of clients being accessed via a TCP/IP network, the Infiniband-to-native protocol translation apparatus comprising: an unaccelerated connection processor, configured to bridge the TCP/IP transactions between the plurality of clients and the plurality of Infiniband devices by encapsulating/stripping the TCP transactions within/from Infiniband raw packets, said unaccelerated connection processor comprising: a target channel adapter, coupled to said unaccelerated connection processor,

configured to receive/transmit said Infiniband raw packets from/to the plurality of Infiniband devices.

The Examiner furthermore noted that Johnson teaches an unaccelerated connection correlator, for mapping native addresses to/from Infiniband local indentifiers and work queue numbers. The Examiner concluded that it would have been obvious to one of ordinary skill in the art at the time of invention to combine the teachings of Susnow and Johnson because they both deal with improving system I/O speeds.

Applicant respectfully disagrees with the Examiner's characterization of the teachings of Johnson and associated reasons given for combining the teachings of Susnow and Johnson. First, Johnson teaches a method of responding over an I/O message passing medium, to a request message and to provide an associated reply descriptor for transmission over an I/O message passing medium in response to a corresponding request message.. A reply message need only be generated if at least one predefined condition is not met. The reply descriptor includes at least one indication field that identifies its type and a content field, whereby the content field comprises information of the reply message's storage location (in the event so generated) (col. 5, lines 12-22). In an embodiment directed towards improvement of SCSI communications, a general context reply descriptor is presented in Fig. 3B and discussed. In Figs. 3E-3F, more general embodiments of his reply descriptor are illustrated and discussed. Yet in each of the cases, Johnson's discussion of the corresponding fields lead one skilled in the art to conclude that such construction of a protocol is for primary employment for the transfer of I/O data, as in SCSI, or Fiber Channel devices. Nowhere therein does Johnson provide any motivation or suggestion to provide an unaccelerated connection correlator, for mapping native addresses to/from Infiniband local indentifiers and work queue numbers in the context of routing TCP/IP transactions between a plurality of clients and a plurality of Infiniband devices where TCP/IP transactions between the plurality of clients and the plurality of Infiniband devices are bridged by encapsulating/stripping the TCP transactions within/from Infiniband raw packets.

In addition, Applicant respectfully asserts that it is improper to conclude that one skilled in the art would be led to combine the teachings of Susnow and Johnson to yield the elements recited in claim 40 because Susnow does not teach how to route TCP/IP transactions between a plurality of clients and a plurality of Infiniband devices. Susnow teaches a link synchronization technique that is provided to overcome deficiencies in VI, to wit, VI does not provide for link synchronization. Furthermore, neither Susnow nor Johnson teach intercepting commands provided to corresponding TCP/IP stacks.

Accordingly, Applicant respectfully requests that the rejection of claim 40 be withdrawn.

With respect to claims 41-45, these claims depend from claim 40 and add further limitations that are neither anticipated nor made obvious by Susnow, Johnson, or Susnow and Johnson in combination. Accordingly, Applicant respectfully requests that the Examiner withdraw his rejections of claims 41-45.

The Examiner also rejected claims 23-26 under 35 U.S.C. 103(a) as being unpatentable over Susnow in view of "Virtual Interface (VI) Architecture Overview", Pathikonda et al., 1998 (hereinafter Pathikonda) and further in view of Cheriton. The Examiner initially concedes that Susnow does not explicitly teach a method for accelerating TCP/IP connections in a client server environment having clients that are connected to a TCP/IP network and server that are connected to an Infiniband fabric, but that in a similar system, Pathikonda teaches the queue in VIA, in accordance with Virtual Interface Architecture Version 1.0 Specification, there are work queues on the host, see for example, pg 22 for additional details. The Examiner concluded that it would have been obvious to the person ordinary skill in the art at the time of the invention to combine teachings of Susnow and Pathikonda because mapping of connection parameters between two queue pairs as taught in Virtual Interface Architecture version 1.0 of Pathikonda, would lead to mapping of TCP/IP parameters for accelerated connections to corresponding host and target work queue pairs of Susnow, and would enhance the performance of Susnow via rDMA processes.

In addition, the Examiner noted that Susnow does not explicitly teach: offloading TCP/IP processing otherwise performed by the servers by executing Infiniband remote direct

memory access operations to retrieve/transmit data associated with the accelerated connections from/to memory within the servers. The Examiner then notes that Cheriton teaches using RDMA in a TCP/IP framework (Col. 3, lines 39-57) and concludes that it would have been obvious to the person ordinary skilled in the art at the time of the invention to combine teachings of Susnow and Cheriton and to have used RDMA to accelerate TCP/IP communications in Susnow's system for the performance gain achieved by using RDMA

Applicant respectfully disagrees and notes that although Pathikonda teaches work queues in VIA, as argued above, Pathikonda also teaches that VI does not specify an underlying transport mechanism. Therefore, one skilled will concur that it does not follow that Pathikonda can teach mapping of TCP/IP connection parameters to a work queue because he does not allude to TCP/IP. And Susnow certainly does not address this attribute of the present invention. Moreover, neither Susnow, Cheriton, Pathikonda, or any combination of these references teach first intercepting requests to send/receive data provided to the servers' TCP/IP stacks and offloading TCP/IP processing otherwise performed by the servers by executing Infiniband remote direct memory access operations to retrieve/transmit data associated with the accelerated connections from/to memory within the servers. As has been noted numerous times, Susnow is silent on acceleration of TCP/IP connections, Cheriton teaches reduction of intermediate buffer copies by providing a shim protocol above TCP, and Pathikonda teaches, among other things, that VI is interconnect independent. Consequently, it does not follow that these references can provide motivation to one skilled in the art to accelerate TCP/IP connections in a client-server environment having clients that are connected to a TCP/IP network and servers that are connected to an Infiniband fabric by first intercepting requests to send/receive data provided to the servers' TCP/IP stacks; then mapping TCP/IP connection parameters for accelerated connections to corresponding host and target work queue pairs; and finally offloading TCP/IP processing otherwise performed by the servers by executing Infiniband remote direct memory access operations to retrieve/transmit data associated with the accelerated connections from/to memory within the servers.

In view of the above reasons, Applicant respectfully suggests that the rejection of claim 23 be withdrawn.

With respect to claims 24-26, these claims depend from claim 23 and add further limitations that are neither anticipated nor made obvious by Susnow, Cheriton, Pathikonda, or any combination of Susnow, Cheriton, and Pathikonda. Accordingly, Applicant respectfully requests that the Examiner withdraw his rejections to claims 24-26.

CONCLUSIONS

In view of the arguments advanced above, Applicant respectfully submits that claims 1-45 are in condition for allowance. Reconsideration of the rejections is requested, and allowance of the claims is solicited.

Applicant earnestly requests that the Examiner contact the undersigned practitioner by telephone if the Examiner has any questions or suggestions concerning this amendment, the application, or allowance of any claims thereof.

I hereby certify under 37 CFR 1.8 that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office on the date of signature shown below.

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